

EVALUATION OF MEAN PLATELET VOLUME AS A PROGNOSTIC MARKER IN TYPE II DIABETES MELLITUSNavya B. N.¹, Dhanalakshmi D. P.², Vivek T. G.³, Kariappa T. M.⁴**HOW TO CITE THIS ARTICLE:**

Navya B. N, Dhanalakshmi D. P, Vivek T. G, Kariappa T. M. "Evaluation of Mean Platelet Volume as A Prognostic Marker in Type II Diabetes Mellitus". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 19, March 05; Page: 3261-3266, DOI: 10.14260/jemds/2015/472

ABSTRACT: BACKGROUND: Diabetes mellitus (DM) is both metabolic disorder and a major worldwide health problem because of its high prevalence and mortality. The prevalence of cardiovascular complication of type II DM may be associated with glycosylated hemoglobin (HbA1c) and mean platelet volume (MPV). **AIM:** 1. To investigate if platelets were activated in diabetes and its associated complications by measuring the MPV in diabetics compared to non-diabetics. 2. To determine the correlation of MPV among diabetics with Fasting blood Glucose levels (FBS), HbA1c, duration and complications of diabetes respectively. **MATERIALS AND METHODS:** A prospective study was carried on 200 diabetic patients and 200 control subjects. Both the groups underwent thorough clinical examination in terms of complications and duration of diabetes and laboratory investigations was performed. Laboratory investigations such as haemoglobin (Hb), white blood count (WBC), platelet count (Plt), MPV, FBS and HbA1c values of the participants were recorded. **RESULTS:** We could find significant increase in MPV among diabetics (8.83 ± 0.72 fl) when compared to non-diabetics (7.62 ± 0.47 fl) with a P value of 0.001. MPV showed a strong positive correlation with fasting blood glucose level, HbA1c levels, duration and complication of DM. **CONCLUSION:** MPV is associated with increase in FBS, HbA1c, duration and complications associated with DM. Therefore, MPV might be a useful prognostic marker of cardiovascular complications in patients with type II DM. **KEYWORDS:** MPV, DM, HbA1c.

INTRODUCTION: Diabetes mellitus is a common health concern worldwide, especially type II DM has reached an epidemic level in both developed and developing countries.¹ Type II DM is a part of metabolic syndrome which comprises of dyslipidemia, hypertension, impaired fibrinolysis and increase pro coagulation factors.^{2,3} The prevalence of cardiovascular risk complication of type II DM may be associated with blood glucose concentration, HbA1c and MPV.^{4,5,6,7} MPV is a new and independent risk factor for atherothrombosis. Studies have shown that increased MPV is a risk factor for myocardial infarction, cerebral ischemia, and transient ischaemic attacks.

The aim of the present study was to investigate if platelets were activated in diabetes by measuring the MPV in diabetes compared to non-diabetes and to determine the correlation of MPV among diabetes with fasting blood glucose levels, HbA1c levels, duration of DM and DM with and without complications.

MATERIALS AND METHODS: A prospective study was carried on 200 diabetic patients and 200 control subjects (Non-diabetics). All the diabetics and healthy subjects had a thorough clinical examination in term of micro/macro vascular complications, duration of complications and history of drug usage. Laboratory investigations such as haemoglobin (Hb), white blood count (WBC), platelet count (Plt), MPV, FBS and HbA1c values of the participants were recorded. MPV was analyzed using

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automated blood counter mind ray. BC 3000 plus. HbA1c was measured by mispai and serum glucose by glucose oxidase method using auto analyzer.

INCLUSION CRITERIA:

1. Non diabetic patients with no clinical features of diabetes and with blood glucose levels and HbA1c levels within normal limits.
2. Patients with signs and symptoms of diabetes and with higher level of blood glucose level and HbA1c levels.

EXCLUSION CRITERIA:

1. Patients with iron deficiency anaemia, nutritional anaemia, hypo-hyperthyroidism, recent infections, malignancy and patients on antiplatelet drugs.

STATISTICAL ANALYSIS: Statistical evaluation was performed by using SPSS programme version 17 using Z test for two sample means and Pearson correlation test(r value as the coefficient). Data was expressed as mean \pm standard deviation. A p value <0.05 was considered statistically significant and p value <0.001 was considered highly significant.

RESULTS: Among the 200 diabetic subjects, there were 132 males and 68 female diabetics and among 200 non-diabetic subjects there were 98 males and 102 non-diabetic females (Table 1). The mean age of the diabetic population was 55 ± 10.7 years, whereas that of non-diabetic population was 47 ± 4.5 years. The mean duration of diabetes was 8.17 ± 5.43 years. Out of the 200 diabetics, 135(67.5%) had complications such as hypertension, diabetic retinopathy, autonomic neuropathy, peripheral vascular disease, diabetic foot and diabetic nephropathy while 65(32.5%) did not have any of these complications. The mean FBS level in the diabetic population was 186.7 ± 60.2 mg/dl while that of the non-diabetic group was 78.9 ± 4.63 mg/dl ($p<0.001$). The mean HbA1c level in the diabetic population was $8.86\pm 0.68\%$ as compared to $5.71\pm 0.22\%$ of the non-diabetic group ($p<0.001$). The mean platelet count in the diabetic group was $3.04\pm 0.6\times 10^6/l$ as compared to $2.76\pm 0.85\times 10^6/l$ of the non-diabetic group. The mean Hb in the diabetic group was 13.39 ± 1.04 gm% as compared to 14.8 ± 5 gm% of the non-diabetic group ($p<0.059$). In the diabetic subjects, MPV was significantly higher (8.83 ± 0.72 fl) as compared to the non-diabetic group (7.62 ± 0.47 fl; $p<0.001$). Among the diabetic subjects, a positive statistical Pearson correlation was seen between MPV and HbA1c levels($r=0.24$), FBS levels ($r=0.19$) and duration of complications ($r=0.19$) (table 2 and graph 1). There was an increase in mean MPV in patients with diabetes mellitus with complications (8.859) when compared to diabetes without complications (8.79) but was not statistically significant.

DISCUSSION: Diabetes mellitus is a chronic condition that can lead to complications over time. The prevalence of diabetic micro vascular complications is higher in people with poor glycaemic control, longer duration of DM, associated hypertension, and obesity. This leads to increased morbidities and mortalities in DM.^{8,9}

Sustained hyperglycemia leads to a series of interrelated alterations that can cause evident endothelial dysfunction and vascular lesions in diabetic complications. Formation of advanced glycation end products, activation of protein kinase C and disturbances in polyol pathways are the possible mechanisms by which increased glucose induces vascular abnormalities.¹⁰

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Kakouros N et al suggested that hyperglycemia causes to generate larger platelets and abnormal platelet-endothelial interactions have been identified as an essential pathogenic mechanism in the development of atherosclerosis.¹¹ The patients with type 2 DM have larger platelets that are more reactive and aggregable. Some authors speculated that vascular complications in diabetes should be consequence of increased platelet activity. Activated platelets tends to be larger in diameter resulting in elevation in MPV.¹² MPV is found to be significantly higher in diabetic patients, thereby playing role in the micro- and macro vascular complications. Although several measurements of platelet activity have been emerged as potential contributors to athero thrombosis, many of these measurements are time-consuming, expensive, uses high sample volume, or require speciality training.^{13,14} Alternatively Mean Platelet Volume (MPV), a marker of platelet size is easily determined on routine automated hemograms and routinely available at a relatively low cost.^{15,16} MPV is a simple and cost effective tool which can be explored for predicting the acute vascular events in patients suffering from diabetes mellitus.

In our study, the mean platelet count in the diabetic group was higher than that of the non-diabetic group which was similar to the studies done by Kodiatte et al.¹⁰ and Zuberi et al.⁹ The mean platelet count depends on several variables, that is mean platelet survival, platelet production rate, and turnover rate in DM.

The values of MPV in our study were significantly higher in diabetic patients compared to non-diabetics which is in accordance with the study conducted by Zuberi BF et al.⁹ which showed that MPV was significantly increased in diabetic group as compared to non DM group. We also found increased MPV in diabetic subjects with complications when compared to DM without complications but were not statistically significant.

Among the diabetics, we found a strong positive correlation between the MPV and HbA1c levels which was similar to the study done by Demeirtunc et al.¹⁷ Study by Kodiatte et al¹⁰ showed no association between MPV and duration of DM which was in contrast to our study where there was association between MPV and duration of DM. Muscari et al¹⁸ showed that MPV values were associated with fasting glucose levels in Italian subjects. However, these subjects were not entirely representative of the general population because most of the subjects were elderly (mean age, 72.9 years), hypertensive (86%), hypercholesterolemic (47%), and overweight or obese (46%). In the present study, we found a strong association between MPV and fasting glucose levels. Many authors have concluded that glycemic control reduces the platelet activity and it may prevent or delay vascular complications in patient with type 2 DM.

CONCLUSION: Type 2 DM is a prothrombotic state due to increased platelet activity. MPV is associated with increase in FBS, HbA1c, duration and complications associated with DM. Increased MPV can generate a procoagulant effect and can cause thrombo vascular complications. Therefore, MPV might be a useful prognostic marker of cardiovascular complications in patients with type II DM.

LIMITATION: Small sample size and study restriction to small geographic area are considered as two important limitations of our study.

RECOMMENDATION: Further research studies are needed to support and to assess the real benefits of our study findings in wide population.

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Characteristics	Diabetics	Non diabetics	P value
Number	200	200	
Age (yrs.)	55.35±10.7	47.5±4.54	
Males (number of patients)	132	98	
Females (number of patients)	68	102	
Mean duration of diabetes (yrs.)	8.175±5.43	-	
Macro and microvascular Complication (number of patients)	135	-	
Fasting blood sugar (mg/dl)	186.7±60.21	78.9±4.63	<0.0001
Post prandial blood sugar	257.02±69.31	130.8±5.53	
Hba1c (%)	8.86±0.68	5.71±0.22	<0.0001
Hemoglobin (gm%)	13.39±1.04	14.8±5	0.059
Platelet count(x10 ⁶ /l)	3.04±0.68	2.76±0.85	-
Mean platelet volume(fl)	8.83±0.72	7.62±0.47	<0.001

Table1: Comparison of various parameters between the diabetic and non-diabetic subjects

MPV	HbA1c	0.24
MPV	FBS level	0.19
MPV	Duration	0.19

Table 2: Correlation of MPV with various parameters among diabetic group Characteristic r- value

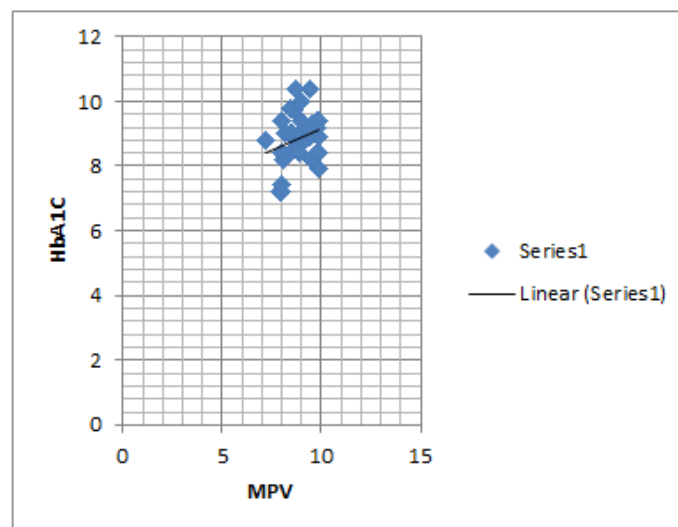


Fig. 1: Graph shows relation between HbA1c and MPV. As the HbA1c increases we can see increase in the MPV value (linear line)

REFERENCES:

1. Haffner S. The Metabolic Syndrome: Inflammation, Diabetes Mellitus, and Cardiovascular Disease. *The American Journal of Cardiology*. 2006; 97(2):3-11.
2. Colwell J, Nesto R. The Platelet in Diabetes: Focus on prevention of ischemic events. *Diabetes Care*. 2003; 26(7):2181-2188.
3. Gündogan K, Bayram F, Capak M, Tanriverdi F, Karaman A, Ozturk A et al. Prevalence of Metabolic Syndrome in the Mediterranean Region of Turkey: Evaluation of Hypertension, Diabetes Mellitus, Obesity, and Dyslipidemia. *Metabolic Syndrome and Related Disorders*. 2009; 7(5):427-434.
4. Ulutas KT, Dokuyucu R, Sefil F, et al. Evaluation of mean platelet volume in patients with type 2 diabetes mellitus and blood glucose regulation: a marker for atherosclerosis? *International Journal of Clinical and Experimental Medicine*. 2014; 7(4):955-961.
5. Andersson C, van Gaal L, Caterson I, Weeke P, James W, Couthino W et al. Relationship between HbA1c levels and risk of cardiovascular adverse outcomes and all-cause mortality in overweight and obese cardiovascular high-risk women and men with type 2 diabetes. *Diabetologia*. 2012; 55(9):2348-2355.
6. Han J, Choi D, Choi S, Kim B, Ki Y, Chung J et al. Stroke or coronary artery disease prediction from mean platelet volume in patients with type 2 diabetes mellitus. *Platelets*. 2013; 24(5):401-406.
7. Papanas N, Symeonidis G, Maltezos E, Mavridis G, Karavageli E, Vosnakidis T et al. Mean platelet volume in patients with type 2 diabetes mellitus. *Platelets*. 2004; 15(8):475-478.
8. Vernekar PV, Vaidya KA. Comparison of Mean Platelet Volume in Type 2 Diabetics on Insulin Therapy and on Oral Hypoglycaemic Agents. *Journal of Clinical and Diagnostic Research : JCDR* 2013; 7(12):2839-2840. doi:10.7860/JCDR/2013/7636.3771.
9. Zuberi BF, Akhtar N, Afsar S. Comparison of mean platelet volume in patients with diabetes mellitus, impaired fasting glucose and non-diabetic subjects'. *Singapore Med J* 2008. 2015; 49(2):114-116.
10. Kodiatte T, Rao S, Manikyam U, Reddy M, Lakshmaiah V, Jagadish T et al. Mean platelet volume in type 2 diabetes mellitus. *J Lab Physicians*. 2012; 4(1):5.
11. Kakouros N, Rade J, Kourliouros A, Resar J. Platelet Function in Patients with Diabetes Mellitus: From a Theoretical to a Practical Perspective. *International Journal of Endocrinology*. 2011; 011:1-14.
12. Cakir L, Aktas G, Enginyurt O. Mean platelet volume increases in type 2 Diabetes Mellitus independent of HbA1c levels. *Acta Medica Mediterranea* 2014. 2015; 30:425-428.
13. Michelson A. Methods for the Measurement of Platelet Function. *The American Journal of Cardiology*. 2009; 103(3):20A-26A.
14. Nicholson N, Panzer-Knodle S, Haas N, Taite B, Szalony J, Page J et al. Assessment of platelet function assays. *American Heart Journal*. 1998; 135(5):S170-S178.
15. Martin J, Trowbridge E, Salmon G, Plumb J. The biological significance of platelet volume: Its relationship to bleeding time, platelet thromboxane B2 production and megakaryocyte nuclear DNA concentration. *Thrombosis Research*. 1983; 32(5):443-460.
16. Jakubowski JA, Thompson CB, Vaillancourt R, Valeri CR, Deykin D. Arachidonic acid metabolism by platelets of differing size. *Br J Haematol*. 1983; 53:503-11.

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17. Demirtunc R, Duman D, Basar M, Bilgi M, Teomete M, Garip T. The relationship between glyceemic control and platelet activity in type 2 diabetes mellitus. J Diabetes Complications. 2009; 23:89-94.
18. Muscari A, De Pascalis S, Cenni A, Ludovico C, Castaldini N, Antonelli S, Bianchi G, Magalotti D, Zoli M: Determinants of mean platelet volume(MPV) in an elderly population: relevance of body fat, blood glucose and ischemic electrocardiographic changes. Thromb Haemost 2008, 99:1079-1084.

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